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mounted gradients of 1 in 25, and even 1 in 23; therefore a gradient of 1 in 30 could not be considered impracticable. Moreover, stationary engines might be used for limited distances, besides inclined planes, assisted by descending weights of mineral from high elevations.

The CHAIRMAN could hardly agree with Mr. Hamilton in considering that this was a topic which the Geographical Society could not entertain. On the contrary, he thought, with Admiral FitzRoy, that the Society was bound to entertain projects of such vast importance.

GENERAL J. E. PORTLOCK, F.R.G.S., thought it right to correct a small error which had been made. It had been observed that 200 feet in a mile was in the proportion of 1 in 30. The English mile, composed of 5280 feet—not the geographical mile—being that used in engineering calculations, 200 feet in a mile would be a little less than 1 in 26½. This fact was noticed with a view of putting the question on the most fair ground, as 1 in 26½ feet is so nearly the same as 1 in 25, stated by Admiral FitzRoy to have been about the steepest slope effected in American railways. The work, therefore, is doubtless one of great difficulty, but, in the opinion of General Portlock, by no means insuperable.

MR. HAMILTON explained that he had taken the nautical mile of 6000 feet. According to General Portlock's calculation, the difficulty would be even greater than he had estimated.

The second Paper read was—

2. *The Curia Muria Islands.* By GEORGE BUIST, LL.D., COR. F.R.G.S., &c.

THIS group, from its many peculiarities always interesting, physically considered, but which might, if presenting no farther claims than this on our attention, have continued neglected as before, has of late become famous from the treasures of guano it was alleged to contain, and from the large sums of money expended with the view of securing these and turning them to account. Though the manure is only found on two of the smallest of the group—Jebeliyah and Hasiki—it was computed to amount, when they were examined in 1852, to 200,000 tons, and it is asserted that 45,000 tons have, up to the end of 1858, been exported. In the beginning of the last-named year there were some 50 vessels at anchor off the islands, of a total freight of probably 45,000 tons. In September, 1857, I saw at Aden 27 vessels destined for the Curia Murias, and freight to the extent of 80,000 in all has probably visited them within the past three years. A man-of-war has generally been in attendance as a survey or guard-ship, and probably not less than a quarter of a million sterling has, within four years, been expended on this adventure.

The officers of the Indian navy are conducting an extended and minute survey of the islands, and will doubtless present us with charts, characterised by the minuteness and accuracy which have hitherto distinguished the labours of that body. Captain Pullen, of

H.M.S. *Cyclops*, has given us a set of deep-sea soundings made for telegraph purposes of the greatest interest; and what is now required is an examination of the group, not only with the view of describing their physical characteristics, but more especially with the object of setting at rest the question as to their guano-producing capabilities.

Arrian * is the first author by whom the Curia Murias are mentioned under the designation of the islands of Leuobins. Idrisi speaks of them under the name of Khartan Martan. A Venetian officer, who accompanied the expedition of Soliman Pasha against the Portuguese of Diu in 1540, visited them, with the ships, in quest of water. He merely speaks of them as barren, and thinly inhabited. From this period to the date of the survey in 1834-35 they are scarcely noticed anywhere.

The group, situated between the 56th and 57th meridians, and 17th and 18th parallels, consists of five islands, stretching over an elliptical patch of sea 8 miles by 20, whose larger axis is from east to west, approaching within 20 miles of the Arabian coast—1. Helániyah; 2. Rodondo; 3. Sodáh; 4. Jebeliyah; 5. Hasiki; the most remote being less than 35 miles. They are situated in a large bay from Ras Nas to Ras Sheshedat, some 70 miles across, and from Helániyah, which is just on the chord, 35 miles in depth.

1st. *Helániyah* is 7¾ miles in length, 4½ in breadth, and nearly 20 nautical miles in circumference. On the north-eastern side of the islands is a large bay called Ghulbat or Rohib; measured from the great bluff where it begins, it is 3¾ miles in a straight line across, and 1½ mile deep, its area being about 18 square miles. The island is remarkable for its perfect sterility and the ruggedness and irregularity of its outline. The centre of the island rises into a group of sharp peaks or spires, one of which attains the elevation of 1510 feet; from these spurs and ridges run out in all directions, lesser hills filling up the intervals. The steep precipitous points of the island along shore and through the interior are covered with coarse gravel and sand. On the eastern extremity of the island the contour of the hills suddenly alters to a bold and precipitous headland of 1645 feet in altitude, pushing out into the sea; its position, as given by Captain Haines, is 17° 32′ 43″ N., 56° 7′ 17″ E., and consisting of tertiary limestone, the rest of the island being granite, hornblende, rock, or porphyry.

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* *See* Paper by Dr. Hulton, surgeon in 1835 on board the survey ship, Reports of Geographical Society, Bombay, 1836, p. 183; also Captain Haines' Survey Report, Transactions of the Royal Geographical Society of London, vol. xv., 1845, p. 131; and Bombay Geographical Transactions, 1854, vol. xi.

2. *Gurzawt*, *Agarezawt*, or *Rodondo*, the last being the name by which it is usually known among European navigators, is a small rocky island about two miles in circumference, about six miles to the north of Helániyah. It consists of a mass of four rocks at the base all grouped together; then of two conical peaks of unequal size, the higher attaining an elevation of about 200 feet above the level of the sea. There is a small rocky island about 300 yards to the westward of Rodondo, and another about half this distance to the north-west, with channels of from 8 to 13 fathoms between.

3. *Sodáh*, six miles to the westward of Helániyah, stands next to it in point of size. It is about three miles in length by two in breadth. It forms an oblong concave in its longer side, with a fine bay 1500 yards deep,* the entrance being about 900 across. It consists of a group of rugged, barren, independent hills, rising in a vast shapeless mass near the centre to the altitude of 1310 feet; gravel and sand abounding all along the sea-shore and in the harbours in the interior.

4. *Jurzat*, *Kibbiah*, or *Jebeliyah*, the easternmost of the group, is somewhat oval, and 3 miles in the longer by 2 in the shorter diameter. It consists, like the rest, of a collection of detached hills more rounded and less pointed than the others, the highest of them attaining an altitude of 560 feet. There are a number of small peaked islands immediately around the shore, with multitudes of sunken rocks rising just above the surge.

5. *Hasiki*, the westernmost of the group, is 3⅔ miles long by ¾ broad, lat. 17° 27′ 16″, long. 55° 40′ 49″. It attains an elevation of about 500 feet, and has a sunken rock to the westward of 150 yards in length.

Captain Haines and Dr. Hulton, neither claiming to be professed geologists, though both excellent observers, are the only authorities we have as to the geology of these islands; but the valuable papers of Dr. Carter on the southern coast of Arabia afford us much collateral light. The Curia Murias, with the exception of the great bluff of the Helániyah group, consist entirely of plutonic rocks, granite, syenite, porphyry, and hornblende rock:†—

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* Haines, Transactions of Royal Geographical Society of London, 1845, p. 130; and Bombay Geographical Transactions, 1854. How much it is to be regretted that the papers of Captain Haines and Dr. Hulton were not examined when the guano adventures first began in 1856! The sailing directions of Captain Haines are so valuable that a reprint of them ought to accompany any new survey.

† I give hornblende-rock on my own authority; Dr. Hulton calls it greenstone, but his description corresponds much more closely with what I have designated it than what he assumes it to be. The structure of the Curia Murias seems closely to resemble that of the granite and hornblende rocks at Vingorla. Dr. Carter

"As we approach the centre of Curia Muria Bay on the mainland" (says Dr. Carter), "a totally different aspect presents itself. Here we observe Ras Shuamiyah, which is about 135 miles from Ras Jazirah, another and much more extensive outbreak of igneous rocks than at the latter point. The former cape consists of a dark-looking mass of igneous rocks, and on either side of it black dykes irregularly extend up through the white strata, in some places raising them and running along between them, in others attaining the summits and flowing along the surface of the cliff, the uniformity of which has been destroyed by the eruption. In some parts it is raised higher than we have hitherto seen it, in others it is more depressed; a few miles south-west the irregularities still increasing, bring us to a stupendous mass 4000 feet above the level of the sea. Proceeding onwards south-westerly we come to the promontory called *Ras Nus*, which terminates Curia Muria Bay—a mass of granite rising 1200 feet above the level of the sea."

Dr. Carter's account of the mainland, here slightly abridged, corresponds exactly with that of Dr. Hulton of the Curia Muria rocks. With the exception of the limestone bluff at its northern extremity, Helániyah consists of a mass of granite penetrated in all directions, and occasionally surmounted, by a dark-coloured rock, which he describes as allied to greenstone, and which, as already stated, I have assumed to be hornblende rock. It occasionally puts on the form of veins or dykes, varying from a few inches to 18 or 20 feet in thickness. Hornblende is described as the prevailing material of which they are composed, mixed to a greater or less degree with felspar—sometimes in a disseminated form, sometimes secreted in crystals forming porphyry. The structure again seems occasionally so to alter that the material of the veins is transformed into something like granite, into which rock it ultimately seems to merge.* The formations throughout the group seem almost perfectly identical, differing merely, and that to a small extent, in the mineralogical character and contour of the rock; the granite presenting lesser or larger crystals or more or less hornblende in one place than another, the dark rocks varying in like manner, neither in any way changing in any of the essentials of their character. The island of Helániyah, where it attains the elevation of 1645 feet above the sea, consists of tertiary limestone, abundant in fossils, of what description is not mentioned by Dr. Hulton; it is shown by Dr. Carter to be

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considers that the rock described by Dr. Hulton is eupotide, which he holds as synonymous with serpentine. 'Geology of Western India,' pp. 569 and 583. Dr. Carter's 'Southern Arabia.'—'Bombay Asiatic Transactions, 1851.'—'Geographical Papers of Western India, 1856.'

* Hulton, slightly abridged. "I am satisfied that more careful examination would show that though the structure of the veins may change its character so as to become closely allied to granite, the veins themselves actually retain their uniformity."—Letter of Mr. Dawson, late Principal Resident and Superintendent for the Lessees.

the same formation as the nummulite capping the igneous rocks on the mainland to the north. There is no trace of alluvium or altered or travelled material on any of the islands, but masses of sand and gravel, the débris of the adjoining rocks, are found in the hollows and valleys in the interior and forming a band along the sea-shore.

So violent is the surge at times that the spray seems to drift far into the interior of the islands, and pools of salt-water are frequently found from 400 to 500 feet above the level of the sea. To this circumstance seems due the abundance of earthy gypsum found among the guano, and which not unfrequently forms the bulk of the substance so called. Wherever salt-water dries up in contact with earthy matter containing lime, the hasty decomposition ensues, and the sulphates in the salt-water transform the carbonate into sulphate of lime. Extensive beds of gypsum, originating probably in the same way, are said to prevail below the guano.

Water is tolerably abundant on these two lesser islands, but it is nearly all brackish. There is one excellently built wall within 400 yards of the shore on the north-eastern part of Helániyah.

The flora of the islands, so far as hitherto dated, consists of a few stunted bushes of camel-thorn, some saliferous shrubs, with a few mangroves within tide-mark and the more sheltered little coves.

The fauna of the Curia Murias is, as may be supposed, as circumscribed as their flora. Rats are in profusion, and their existence is ascribed to the wreck of a vessel. Helániyah is said to mean "Kid or Sheep Island,"* and here goats are found. Wild cats are sometimes seen among the rocks. Of reptiles, the only ones made mention of are the whip-snake and scorpion. Centipedes are plentiful.†

The climate of the Curia Murias, situated a couple of degrees to the southward of Bombay, is singular, and, considering their position, anomalous and inexplicable, but for the high lands in their vicinity. Immediately to the northward and northwestward of the shores of Curia Muria Bay is a vast mass of table-land and mountains extending through Hadramaut to the confines of Yemen, a distance of close on 1000 miles, of a general altitude of from 3000 to 6000 feet. Facing this is, from Ras Morbat to Ras Nus, a precipitous limestone wall of Subhán, varying in elevation from 3000 to 5000 feet; and over these elevated masses furious blasts blow down on the Curia Murias. The wind is called belat or balat by the natives, by whom it is much dreaded. It gives scarcely any warning of its approach, and frequently reduces the thermometer to 50°. In June, July, and August, the south-west monsoon blows with fury, and between December, 1835, and March, 1836, equally severe gales were experienced by Captain Haines, some of them of great violence. In February and March heavy gales from the south-west are frequent, prevailing at times for five or six days on end. In May, 1503, the Portuguese commander was separated from his fleet and wrecked on the islands, and from the remains found by our surveyors like mischances must have been frequent. On the 19th December, 1834, the *Reliance* whaler was wrecked, and the greater frequency with which vessels visit these parts than formerly makes us aware that this is one of the stormiest portions of the Arabian Sea. We have but little information as to the falls of rain in the Curia Murias; they seem infrequent, but violent when they occur, while the utter sterility of the land causes the great bulk of what falls to run off at once into the sea. Dr. Hulton mentions that the setting in of the north-west monsoon is occasionally attended with showers. In want of specific observations, the amount of stones and gravel found amongst the guano, and the almost total absence of all soluble matter, unless where the manure is sheltered by caves or overhanging rocks, fully bear out the assumption I have started with.*

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* Note to Haines' paper, Transactions of Royal Geographical Society, p. 138. Haines and Hulton's, *ut sup.*

† Slightly abridged from Captain Haines' Report, Transactions of the Royal Geographical Society, pp. 127, 149.

The temperature of Curia Muria Bay is singularly low for that latitude. During the south-west monsoon, at the period of the summer solstice, it seldom exceeds 80°. At Bombay, two degrees farther north, it often rises above 90°. In winter it sometimes sinks to 50°, a cold unknown on the seaboard of India. In 1853, H.M.S. *Juno* was nearly dismasted in the violent hurricanes off the Curia Murias, and in consequence of the tempestuousness of these seas during the south-west monsoon the magnificent steamers of the Peninsular and Oriental Company found themselves compelled to abandon the north-western passage, even when it promised a more rapid transit in June, July, and August than the southern détour compelled to be taken. In the middle of April, 1855, the war steamer *Queen* was nearly lost; the Peninsular and Oriental Company's ship *Malta* suffered much during a violent gale south of Curia Muria Bay; and it is stated that, within seven months, we had had two distinct and well-pronounced cyclones developing themselves in the Arabian Sea between the 54th and 56th meridians, and which scarcely seem to have extended over twelve square degrees in all. From the irretrievable barrenness of the Curia Murias, the scarcity both of animal and vegetable life, we are quite prepared to find them almost destitute of inhabitants; but they never seem to have been wholly unpeopled since first mentioned in history. The following is the account given of them by Dr. Hulton * :—

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* A single fall of rain, such as visited the still more rainless pinnacles of Aden in December, 1842, 15th July, 1848, 21st August, 1849, 28th October, 1852, in September, 1853, and March, 1854, or April, 1859, would have swept away the *soluble* elements which give guano all its commercial value, and destroyed the hopes of the gatherers for years to come.

> "Among the people on the southern coast of Arabia, they are usually spoken of as the Juzan of Ghulfan: called so from an enterprising family belonging to the great Mahara tribe. The head of this family, Said bin Oomar bin Haat bin Ghulfan, possessed a small property in the neighbourhood of Morbat, called Howeeys. Being of an active commercial turn he amassed considerable wealth, and, having drawn together a numerous party of adherents, he made a vigorous attempt to possess himself of the government of Morbat. In this, however, he failed, and was compelled to seek refuge in the island of Helániyah. When affairs had become more settled, he returned to Howeeys, reserving to himself and heirs the right of possession in all the islands. His two sons and nephews, regarding the islands as hereditary property, still visit them occasionally for the purpose of collecting any money the natives may have received for watering foreign vessels and bugalahs. These visits are always hailed with pleasure by their poor subjects, as they seldom fail to supply them with a few dates and other necessaries.
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> "Helániyah is the only island in the group which is now inhabited. Its present population consists of twenty-three individuals, who differ nothing in form and complexion from the Arab. They are perhaps somewhat degenerated from their forefathers in strength and bodily vigour, but this may be explained by their extreme poverty and wretched mode of living. The soil of the island is quite incapable of being cultivated in any part, whatever industry or care might be bestowed in the attempt. There is, indeed, barely sufficient vegetation for the support of a few straggling wild goats, which the sterility of the plains and growing neglect of their former possessors have driven to the hills and valleys. Necessity has compelled the inhabitants to look to the sea alone for means of subsistence: in fact, they may be classed with perfect propriety as ichthyophagi; but in any one previously acquainted with their mode of existence, the comparatively healthy aspect of these islanders cannot but excite a certain degree of astonishment."

The enormous flocks of birds, and the amount of excrement which both the Curia Murias and Salt Rocks off the easternmost point of Africa afford, as observed in 1834-35, are mentioned both by Captain Haines and Dr. Hulton. Guano from sea-fowl was not then known as a marketable commodity; had it been otherwise, probably these gentlemen would have surmised that that seen by them was neither of quantity nor quality sufficient to meet charges. In 1845, Mr. Waghorn despatched a light vessel from Suez to examine the various islands in the Red Sea. In 1846, the ship *Northumberland*, having carried out cargo to Aden, crossed over to Salt Rocks, where the display of birds and gossip excited by Mr.

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* *See* Hulton, p. 184 and 185 of Geographical Transactions, Bombay, vol. iii.

Waghorn's adventure led to the belief that guano must abound, and the ship was accordingly loaded with a brownish-looking powder, supposed to be dried excrement.

Salt Rocks, like Socotra, consist of granite, and it is possible the powder was of a kind similar to that brought as guano by the native boat, in 1856, from the Curia Murias.

H. M. S. *Juno*, Captain Freemantle, was, in February, 1854, despatched from England to investigate the matter, and the following July the islands were ceded to the British Government by the Imaum of Muscat. In 1856, Mr. Ord "fitted out an expedition and proceeded to the Curia Murias." They were met by a horde of armed Arabs, who denied the Imaum's right to cede the islands and threatened to shoot the invaders if they did not instantly retire. Mr. Ord once more applied to Government, and H. M.'s Steamer *Cordelia* was despatched, on the 6th June, 1857, to protect the guano seekers against the Arabs; on arriving, on the 14th of September, at the Curia Murias, the *Cordelia* found no opposing Arabs. The *Cordelia* visited Bombay in November in quest of provisions, returning again to the Curia Murias.

The CHAIRMAN expressed his obligation to Dr. Buist for having dispelled their ignorance with respect to the supposed occurrence of large masses of *guano* in the tract under consideration. But still even there phosphatic substances might be found which would prove to be of some value to our agriculturists. For instance, there had been recently discovered in the Anguilla islets, in the West Indies, deposits of this nature. An American vessel got becalmed off a rock called Sombrero, north of St. Kitt's and the Anguilla isles, and there the captain found a deposit of *fossil* bones and guano. Specimens having been carried to New York, were analysed and found to be worth from 4*l*. to 6*l*. 10*s*. per ton, and since then this little rock had been stripped of its deposit to the value of 200,000*l*. sterling. Sir Hercules Robinson, the late governor of St. Kitt's, having heard of this adventure, had sent home specimens of a similar deposit on our own Anguilla islands, which had been submitted to Sir Roderick's examination, and he had no hesitation in saying that the substance might prove to be of value to the agriculturist. He had recommended to Her Majesty's Government that a geologist should be sent to these islets, to discover whether some of them may not be as valuable as the rock of Sombrero.

MR. J. CRAWFURD, F.R.G.S., observed that it was utterly impossible that good guano could exist on the Curia Muria islands, lying within the south-west monsoon, and where, consequently, there were torrents of rain. Guano existed only in certain latitudes on the western coast of America, where no rain ever fell, and there necessarily only on uninhabited islands. The Chairman had said that the island of St. Kitt's might give us a substance equal in value to guano; the price showed clearly enough that that was not the case.

The CHAIRMAN.—6*l*. 10*s*.

MR. CRAWFURD.—3*l*. 10*s*. was the average price; but even 6*l*. 10*s*. would not be half the value of good Peruvian guano, which in this country was 15*l*.

Sixth Meeting, Monday, February 13th, 1860.

SIR RODERICK I. MURCHISON, VICE-PRESIDENT, in the Chair.

PRESENTATIONS.—*The Revs. T. Butler, and C. S. Allen Dickenson; Consul J. Petherick; Colonels J. F. D. Crichton-Stuart,* M.P., *and J. F. Bateman; R. H. O'Dalyell; and R. H. W. Dunlop, Esqrs., were presented upon their election.*

ELECTIONS.—*Captain J. F. Cooper (7th Royal Fusiliers); Commander H. Carr Glynn,* R.N.; *and David Aitchison; John Ball; G. Wingrove Cooke; David A. Freeman; Nicholas P. Leader; John Rutherford; Henry Wynn Seymour Smith; and John Ingram Travers, Esqrs., were elected Fellows.*

AUDITORS.—*Thomas H. Brooking and E. Osborne Smith, Esqrs., on the part of the Council; and the Rev. Dr. Worthington and Thomas Lee, Esq., on the part of the Society, were elected Auditors for the year.*

The Paper read was—

China; Notes of a Cruise in the Gulf of Pe-che-li and Leo-tung in 1859.

By MR. MICKIE.

Communicated by H. HAMILTON LINDSAY, Esq., F.R.G.S.

SHANG-TUNG and Leo-tung lie on opposite sides of the Gulf of Pe-che-li. They are mountainous provinces, similar in character, though separated by a tract of alluvial plain. Their opposite shores are connected, across the gulf that lies between them, by the chain of the Miatao islands.

In April and May, at the close of the dry season, the soil appeared arid in the extreme; every breeze raised a storm of dust; but the rains of June and July filled the watercourses and brought out the verdure. The hills are bare of trees; they are stripped for firewood. Part of their sides are terraced for cultivation, and sown with Indian corn and millet.

The climate during spring and summer, is undoubtedly good; there is no malaria, and the air is dry and pure. The cold in winter is described as intense. Every man at Che-fow has a fireplace under his bed. The buildings differ from those of South China, being small, substantial, and plain. They are built of stone or brick, and rarely of wood. The people are simple in their habits; they are a hardy race, tall and robust, and live long. The poorer people live on Indian corn, the others on wheaten bread, and, in winter, all of them consume much animal food. The population lives by agriculture, fishing, and carrying produce. Each donkey or mule